

City of Riverside

Building & Safety Division

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www.riversideca.gov



❖PHOTOVOLTAIC PERMITTING GUIDELINES❖

The information provided in this document is general and is intended only as a guide. Each project is unique and additional requirements may apply.

PLANS AND PERMITS

In order to minimize installation problems, plans must be provided that show compliance with all applicable codes. Because of the inherent complexities and potential hazards associated with photovoltaic systems, a California Registered Electrical Engineer or a California Licensed Electrical (C-10) or Solar (C-46) Contractor is required to prepare and sign the plans. In order to expedite the plan review and approval process, it is recommended that the plans include all of the information discussed in this informational handout.

Site Plan

Provide a fully dimensioned site plan showing property lines, all structures, and the location of the main electrical service, all photovoltaic inverters and disconnects, etc.

Roof Plan

Provide a roof plan showing the location of the photovoltaic panels and any required walkways to roof mounted equipment (including any roof mounted heating and air conditioning equipment, etc.). Roof plans should also identify the size and spacing of the existing roof framing members and the slope of the roof plus any required roof framing alterations needed.

Attachment Details

Provide details to show how the photovoltaic panels will be secured to the roof.

Engineering Calculations

Engineering calculations may be required on some photovoltaic systems to show that the existing roof is strong enough to support the added weight of the system.

Electrical Single Line Diagram

Provide a complete electrical single line diagram showing all electrical equipment, conductor size and type, conduit sizes, overcurrent protection location and ratings, grounding electrode type and location, point of interconnection to existing service panel (i.e. backfed breaker), etc.

Product Specifications and Literature

Provide specifications on the inverters, solar panels, disconnect boxes and solar panel anchorage system to be used.

Signage Specifications

Provide a legend showing locations and wording of all required signs or placards at various photovoltaic system components.

STREAMLINING THE PLAN REVIEW PROCESS

The following information represents many of the most common plan review correction comments and should be helpful in assisting you to prepare a set of plans that are able to be quickly reviewed and approved. Well drawn plans that provide complete and thorough information will be helpful in minimizing installation errors and inspection problems.

TYPICAL GENERAL PLAN CHECK COMMENTS

1. The **font size** used on the plans submitted is too small to be legible and/or the line quality is too light to be reproduced or archived in our database. All plans and specifications or reports must be legible and reproducible on a standard copy machine (not a color copier). Minimum recommended font size is equal to or larger than #12 Times New Roman. In order to comply with our legibility and reproduction standards, it may be necessary to provide plans on a larger size paper (18" X 24" or larger).
2. Please provide a note stating that the **working clearances** around the existing electrical equipment as well as the new electrical equipment will be maintained in accordance with NEC 110.26.
3. Identify any existing **mechanical equipment on the roof** plan and provide a minimum working clearance of 36" around the entire unit as well as a minimum 24" wide clear accessway from the roof scuttle or roof access point. (NEC 110.26 and CMC 904.10)
4. Note on the plans that the **photovoltaic inverter** will be listed as UL 1741 compliant. (NEC 690.4 D)
5. Plans are to be signed by a California Registered Electrical Engineer or a California Licensed Electrical (**C-10**) or Solar (**C-46**) Contractor, with their related California registration or license number. (B & P Code 5537.2, 5537.4 and 6737.4)
6. Please **provide an electrical single line diagram** showing all equipment as well as conductor sizes for all grounding, bonding and current carrying conductors. Show type of grounding electrode(s) used and location(s).
7. The electrical **single line diagram is unclear** as to the point of interconnection to the service. In order for us to evaluate the design, much more information is needed. Please identify the backfed breaker size on the plans. Show all electrical service gear and ampacity rating of busbars and main breaker size.
8. Please note that adequate spacing must be maintained between any **plumbing sewer vents** extending through the roof and the underside of the photovoltaic panels (6" minimum recommended).
9. Identify the location of the **Inverter** on the site plan.
10. A new provision in the 2010 California Residential Code (CRC) requires that **Smoke alarms and Carbon Monoxide alarms** be retrofitted into the existing dwelling. These Smoke alarms are required to be in all bedrooms, outside each bedroom, and at least one on each floor of the house. Carbon Monoxide alarms are required to be retrofitted outside each bedroom and at least one on each floor of the house. These alarms may be solely battery operated if the Photovoltaic project does not involve the removal of interior wall and ceiling finishes inside the home, otherwise, the alarms must be hard wired and interconnected. Please provide a note on the plans to document these requirements. (CRC R314, R315)

TYPICAL WIRING METHOD PLAN CHECK COMMENTS

11. Identify that all exposed photovoltaic system conductors on the roof will be **USE-2** or Photovoltaic (PV) type wire. Identify wire size for all conductors. (NEC 690.31B, 338.10 B 4 b, Table 310.16, Table 310.17)
12. Identify that all photovoltaic system conductors will be **90 degree C rated**. (NEC 690.31B, Table 310.16, Table 310.17)

13. Where DC conductors are run **inside the building (or attic)**, they shall be contained in a metal raceway. (NEC 690.31 E)
14. Identify that all exterior conduit, fittings, and boxes shall be **rain-tight** and approved for use in wet locations. (NEC 314.15).
15. **Line side taps into the busbars or conductors** on the supply side (i.e. between the service entrance conductors and the main overcurrent device downstream of the meter) are **NOT ALLOWED** by the City of Riverside Utility Department. All incoming current from the photovoltaic system must be backfed through a circuit breaker on the load side of the service main breaker. (NEC 690.64 and Utility Dept. policy)
16. **Supply side taps into the existing buss bars** will not be approved without a written authorization and specific instructions from the panel manufacturer for the specific address and panel. Additionally, if the afore mentioned authorizations are provided, a third party inspection and certification of the taps will be required to be provided by the panel manufacturer prior to final inspection approval of the PV system by the City. (NEC 110.3)
17. **Supply side taps into feeder conductors** (Feeder Conductor Taps) must be clearly identified on the single-line diagram. Please identify the wire type and size of the tap conductors and feeder conductors, as well as the length of the tap conductors. All applicable conditions of NEC 240.21 B, based on the length of the tap conductors must be identified on the plans. (NEC 240.21 B)
18. Provide a note stating that any conductors exposed to sunlight shall be listed as **sunlight resistant**. (NEC 300.6 C1, 310.8 D)
19. **Ground mounted** system wiring over 150 volts shall not be accessible, except to qualified personnel. Provide protective fencing, screening or raceways for all wiring over 150 volts. (NEC 690.7 D)
20. All photovoltaic output circuits operating **above 30 volts** shall be installed in readily accessible locations and in electrical raceways. (NEC 690.31 A)

TYPICAL SIGNAGE, MARKINGS, AND LABEL PLAN CHECK COMMENTS

21. Signage information on plan is inadequate, see attached City handout for additional information. As an aid in streamlining your plan preparation, you may simply attach a copy of the City of Riverside "**Photovoltaic Signage Requirements**" handout to your plans.
22. Provide a label or marking in a visible location near the ground-fault indicator stating :
"WARNING – ELECTRIC SHOCK HAZARD - IF A GROUND FAULT IS INDICATED, THE NORMALLY GROUNDED CONDUCTORS MAY BE UNGROUNDED AND ENERGIZED". (NEC 690.5 C)
23. The photovoltaic system disconnecting means shall be permanently marked to identify it as the **"PHOTOVOLTAIC DISCONNECT FOR UTILITY OPERATIONS"**. (NEC 690.14 C 2 and NEM 6.3)
24. A warning sign shall be mounted on or adjacent to the disconnecting means and shall state **"WARNING – ELECTRIC SHOCK HAZARD - DO NOT TOUCH TERMINALS. TERMINALS ON BOTH THE LINE AND LOAD SIDES MAY BE ENERGIZED IN THE OPEN POSITION."** (NEC 690.17)

25. A warning sign shall be mounted on all serviceable panels or boxes and shall state **“WARNING – ELECTRIC SHOCK HAZARD. DO NOT TOUCH TERMINALS. TERMINALS ON BOTH THE LINE AND LOAD SIDES MAY BE ENERGIZED IN THE OPEN POSITION.”** (NEC 690.17)
26. A label or marking shall be provided at the photovoltaic power source (typically at the inverter) indication the following (NEC 690.53):
- a. **Rated maximum power-point current**
 - b. **Rated maximum power-point voltage**
 - c. **Maximum system voltage**
 - d. **Short-circuit current**
 - e. **Maximum rated output current of the charge controller (if installed)-(only applicable to battery systems)**
27. At the point of interconnection between the photovoltaic power and the Utility power (typically at the back-fed photovoltaic breaker at the service) a sign or marking shall be provided to identify the **RATED AC OUTPUT CURRENT AND THE NOMINAL OPERATING AC VOLTAGE.** (NEC 690.54)
28. A sign shall be provided at the main electrical service stating; **“THIS SERVICE ALSO SERVED BY A PHOTOVOLTAIC SYSTEM”** (NEC 705.10) ...OR ...
29. A **DIRECTORY** providing the location of the service disconnecting means and the photovoltaic system DC disconnecting means shall be provided if the two disconnects are NOT at the same location (typically within 10 feet of each other and within sight of each other – with no fences or other barriers between). (NEC 690.56 B)
30. Identify the signage or **labeling specifications**. The following standards are recommended:
- a. Red background with white lettering
 - b. 3/8” letter height
 - c. All capital letters
 - d. Arial or similar font
 - e. Weather resistant material (i.e. engraved plastic)

TYPICAL GROUNDING AND BONDING PLAN CHECK COMMENTS

31. Indicate that all metallic raceways and equipment shall be **bonded** and electrically continuous. (NEC 250.90, 250.96)
32. Indicate that the photovoltaic arrays shall be provided with DC **ground-fault protection**. (NEC 690.5)
33. The **DC grounding electrode conductor** shall be sized according to NEC 250.166. (NEC 690.47 B)
34. The **DC grounding electrode shall be bonded to the AC grounding electrode** and the conductor shall be no smaller than the largest grounding electrode conductor, either AC or DC. (NEC 690.47 C 7)
35. The **AC grounding electrode conductor** shall be sized according to NEC 250.66. (and Table 310.15 B 6 for dwellings) (NEC 690.47 C 2)

36. Indicate in the notes that **grounding bushings** are required around pre-punched concentric knockouts on the DC side of the system. (NEC 250.97)
37. The grounding electrode conductor must be **protected from physical damage** between the grounding electrode and the panel (or inverter) if smaller than #6 copper wire. (NEC 250.64 B)
38. Indicate that the grounding electrode conductor will be **continuous**, except for splices or joints at busbars within listed equipment. (NEC 250.64 C)
39. Identify the **existing grounding electrode type** (i.e. driven rod, ufer, water pipe, or combination of some or all of the previously mentioned). In existing electrical systems that use only a water piping grounding electrode system, an additional grounding electrode (i.e driven rod) shall be provided. (NEC 250.50)

TYPICAL OVERCURRENT PROTECTION AND DISCONNECT COMMENTS

40. The sum of the ampere ratings of the main service breaker supplying power to the busbar from the Utility and the ampere rating of the back-fed breaker supplying power to the busbar from the photovoltaic source shall not exceed **120 percent** of the rating of the busbar or conductor. (NEC 690.64 B 2)
41. In systems with **panelboards connected in series**, the rating of the first overcurrent device directly connected to the output of a utility-interactive inverter shall be used in the 120 percent calculation for all busbars and conductors. (NEC 690.64 B 2)
42. Provide a **DC disconnect** at the inverter. (NEC 690.15)
43. Main Service breaker may only be **downsized** when supporting electrical load calculations are provided. Please provide electrical load calculations to show that the downsizing of the main breaker will remain adequate for the loads at the main panel.
44. Provide a note stating that the backfed PV breaker(s) at the main panel will be installed at the **opposite end** of the bus bar from the main breaker and that a permanent warning label with the following marking will be provided adjacent to the PV breaker(s): **“WARNING – PHOTOVOLTAIC CONNECTION. DO NOT RELOCATE THIS OVERCURRENT DEVICE.”** (NEC 690.64 B 7) *[Note: this requirement is only applicable when the sum of the overcurrent devices feeding the panelboard exceeds 100% of the bus rating.]*

TYPICAL UTILITY DEPARTMENT AND AC DISCONNECT REQUIREMENTS

45. Provide an **externally operated knife blade type** AC disconnect switch which is lockable in the open position and “ON” and “OFF” visible designations which is directly accessible to Riverside Utility Department employees at all times. (NEM 6.3 and NEC 690.17)
46. Provide a note on the plans stating that the AC disconnect is a **“Knife blade” type** disconnect. (NEM 6.3 and NEC 690.17)
47. Identify the **location** of the Utility Disconnect in relation to the main service panel.
48. Indicate that a **photovoltaic meter socket** will be provided within 10” to 72” (center to center of meters) from the existing service meter and that it will be installed between 48” to 75” above the

floor or grade level. Note that the photovoltaic meter will be provided and installed by Riverside Public Utilities when they are the service provider.

TYPICAL HANDICAPPED ACCESS PLAN CHECK COMMENTS

49. Identify the location of the required **handicapped parking space**(s) and loading zone(s) under the new covered parking area.
50. Identify the accessible **path of travel** from the handicapped parking space to the primary entrance of the building. Indicate that the maximum slope and cross slope along this path of travel will be 2% or less, except that the maximum slope of a ramp or curb ramp may be 1:12.

TYPICAL STRUCTURAL PLAN CHECK COMMENTS

51. Due to the additional dead load from the photovoltaic panels and related wiring and roof mounted equipment, the capacity of the existing roof framing to support the added dead load is in question. Please have a California Registered Engineer provide an **engineering analysis** of the existing roof framing to support the added loads. (CBC 3403.2 & 3403.2.3.2)
52. Where photovoltaic panels are mounted on existing **patio covers**, a California Registered Professional Engineer must review and report on the existing **lateral load**-carrying structural elements. The Engineer's report is to show that the demand-capacity ratio of the lateral load-carrying structural elements are not exceeded by more than 10%. (CBC 3403.4 Exception)
53. Provide an engineering analysis, which is stamped and signed by a California Registered Engineer, for the **photovoltaic panel roof attachment** method... OR ... provide the manufacturer's product cut sheets with a California Registered Engineer's stamp and signature on the cut sheets.
54. Provide additional information concerning the **roof framing**. Provide the rafter size, rafter spacing, rafter span (identify any purlins) and roof slope in the areas supporting the solar panels. Some roof framing members on older homes may NOT be designed to carry the additional load of the solar panels.
55. Provide method of **attachment of the solar panels to the roof** framing. Provide listings and/or product approval information.
56. Due to the use of the **ballast hold-down system**, the Engineer of Record will be required to provide Structural Observation and a report stating that the ballast is installed in full compliance with the design and the approved plans. Provide note on plans concerning Structural Observation requirements. (CBC 1702.1, 1710)